भारतीय मानक **IS 18311 : 2023**

Indian Standard

स्मार्ट कम्युनिटी इन्फ्रास्ट्रक्चर — बड़े शहरी क्षेत्रों और उनके आसपास के क्षेत्रों में और उनके बीच तीव्र पारगमन के लिए स्मार्ट परिवहन — दिशानिर्देश

Smart Community Infrastructures — Smart Transportation for Rapid Transit in and Between Large City Zones and their Surrounding Areas — Guidelines

ICS 13.020.20

© BIS 2023

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

September 2023 **Price Group 7**

Smart Cities Sectional Committee, CED 59

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Smart Cities Sectional Committee had been approved by the Civil Engineering Division Council.

Huge numbers of people travel, including commuting, to and from cities and their surrounding areas in a megalopolis on a frequent or daily basis. To meet their needs and provide suitable transportation services, rapid surface transit systems have been developed, including highway buses and trains on enhanced rail tracks. The effectiveness of each mode of transport depends on the travel distance and the number of passengers. Highway buses are convenient for travel distances of up to 200 km. For distances of up to 1 000 km, high speed rail (HSR) provides easy and rapid transit and has been developed and introduced in response to demand in these megalopolises, including for the purposes of inter-city commuting of less than 200 km. HSR uses trains with a large capacity which can reach speeds of over 200 km/h. Such trains run directly into city centers, removing the need for passengers to change services, and offer a high frequency of service, all for a relatively low price. This has proved very popular with residents in these megapolises, as shown in Annex A.

HSR is a successful rapid transit system for people, especially in megalopolises. By installing HSR in megalopolises or on a route connecting a megalopolis and other cities outside this area, the rapid transit of people can easily be achieved and managed, resulting in short travel times that facilitate both political and economic work and promote commercial business. Using such transportation is one solution to a typical city issue in a megalopolis.

Highway bus transportation systems have also been established as highway networks have been extended. Among the benefits of such systems is the ease of planning service routes and schedules, as well as the actual start-up of such bus transportation services, since these companies do not need to prepare extensive and expensive physical facilities such as those required for HSR operations, namely railroad tracks and civil engineering structures, that are built and financed by rail companies at their own or government expense. It is also easy to change both service frequency and routes according to passenger flow. Therefore, highway buses can be an effective means of quickly conveying people for a distance of less than 200 km by optimizing the transport capacity between cities.

These two transportation modes, highway buses and HSR, are examples of indispensable smart transportation for megalopolises which have specific issues regarding cost-effective, accessible and user friendly transport for travellers.

This standard specifies a procedure to organize smart transportation that enables one-day trips by citizens between cities and in a large city zone, including its surrounding areas, and conveys a large number of people at a high frequency in a short time over distances of up to 1 000 km.

In the preparation of this standard, assistance has been derived from ISO 37159 : 2019 ‘Smart transportation for rapid transit in and between large city zones and their surrounding areas’ and Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines, volume I, 2015.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

This standard also aims at satisfying some Sustainable Development Goals by United Nations, especially Goal 3 ‘Good health and well-being’, Goal 7 ‘Affordable and clean energy’, Goal 8 ‘Decent work and economic growth’, Goal 9 ‘Industry, innovation and infrastructure’, Goal 11 ‘Sustainable cities and communities’, Goal 13 ‘Climate action’ and Goal 15 ‘Life on land’.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SMART COMMUNITY INFRASTRUCTURES — SMART TRANSPORTATION FOR RAPID TRANSIT IN AND BETWEEN LARGE CITY ZONES AND THEIR SURROUNDING AREAS — GUIDELINES

1 SCOPE

1.1 This standard specifies a procedure to organize smart transportation that enables one-day trips by citizens between cities and in a large city zone, including its surrounding areas, and conveys a large number of people at a high frequency in a short time over distances of up to 1 000 km.

1.2 Smart transportation aims to promote political and economic work and stimulate business activity by providing citizens with a manner of travel to complete a return trip from their home or place of work to destinations outside their cities on the same day. However, this standard does not designate a procedure for constructing smart transportation facilities.

NOTE — 'One-day trip' means travel from an origin to a destination and back to the origin on the same day. The purpose of such travel is out of the scope of this standard.

2 REFERENCES

The standards given below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards:

IS No.	*Title*
IS 17451 : 2020	Smart community infrastructures — Best practices for transportation — Guidelines
IS 17457 : 2020	Sustainable development of habitats — Vocabulary

3 TERMS AND DEFINITIONS

For the purpose of this standard, the terms and definitions given in IS 17451, IS 17457 and the following shall apply.

3.1 Large City Zone — Area that includes large cities or urban agglomerations connected or related for political or economic reasons.

3.2 Urban Agglomeration — An urban agglomeration is a continuous urban spread constituting a town and its adjoining outgrowths (OGs), or two or more physically contiguous towns together with or without outgrowths of such towns. An urban agglomeration should consist of at least a statutory town and its total population (that is, all the constituents put together) should not be less than 20 000 as per the 2001 census.

3.3 Highway/Inter-City Bus — Transportation to convey people with buses operated on fixed service routes, on which highways are fully or partly incorporated.

3.4 High-Speed Rail — Transportation to convey people with high-capacity trains at a high frequency in a short time over long distances.

NOTE — High-speed trains are generally considered to be those trains running at over 200 km/h, although the International Union of Railways defines them as trains running at over 250 km/h.

4 CONCEPT OF SMART TRANSPORTATION FOR RAPID TRANSIT

4.1 General

This standard describes the performance required for smart transportation to overcome a city issue or how one-day trips can be successfully provided to citizens by transporting a large number of people at a high frequency in a short time for distances of up to 1 000 km between cities located inside or outside a large city zones.

The anticipated smart transportation modes for this purpose are highway/intercity buses, such as bus rapid transport system and high-speed rail (HSR). The former can transport people for distances of up to 200 km, the latter for distances of up to 1 000 km for one-day trips. Both transportation modes should be selected according to the distance and required capacity. For distances over 200 km, HSR should be selected, but either transportation mode is possible for distances of less than 200 km. The required capacity is also a criterion for the selection of a transportation mode. Highway buses have a smaller capacity than HSR. However, this capacity can be easily changed, since more buses can immediately be dispatched or cancelled depending upon the number of passengers received at any particular time. Capacity is usually fixed with HSR.

One other advantage of using highway/intercity buses and HSR for this purpose is to directly connect the city centres in different cities without forcing travelers to change to local services before entering/leaving the city centre. This is always required when travelling by airplane to/from an airport distant from the city centre. No check-in procedures are necessary for bus or train rides, especially when customers purchase paper or e-tickets in advance, enabling passengers to arrive at a station only a few minutes prior to departure. High-frequency services or those departing at fixed times every hour allow customers to travel without timetables. Bus or train services using exclusive highways or tracks enable on-time operation that is undisturbed by other traffic. These time reliable services promote the transportation business, resulting in financial stability. Buses and trains provide 'lot transporting' that is, the conveying of people in the same direction or to the same destination to the same schedule with the same vehicles at a time suitable to a number of citizens. If people travel in their own vehicles to their respective schedules, it causes large energy consumption and heavy traffic congestion, resulting in high CO_2 emissions. Personal car use is uncontrollable traffic and one of the major sources of CO_2 emissions.

When introducing highway buses and HSR, the capital cost is high compared with other transportation modes, due to construction of high standard public roads or railroad tracks. Furthermore, additional technologies need to be developed to operate such buses and trains. However, as every large city zone has already experienced, the higher the service speed offered, the more sharply and effectively the economy grows in the area, if successful. Thus, the introduction of high speed and high-capacity transportation will foster cities and large city zones or urban agglomerations. This alone shows that it is worthwhile introducing such transportation despite the high capital cost. However, it should be confirmed that the target area has a population large enough to financially support a transportation business that requires high initial capital costs when making decisions on the introduction of smart transportation.

4.2 Applicable City Issues

When the issue is to enable one-day trips by citizens between cities within a large city zone or urban agglomerations, including a metropolitan city, with this by a transportation service which can accommodate a large number of people at one time, this smart transportation is applicable.

5 ADOPTION OF SMART TRANSPORTATION FOR RAPID TRANSIT

5.1 Objectives

As mentioned in **4.1**, smart transportation to enable one-day trips by citizens in and between large city zones or urban agglomerations and their surrounding areas can be organized by determining a suitable transportation mode and then installing it while satisfying the requirements in **5.4**. Transportation modes, except airplanes, applicable to smart transportation should be selected by following **5.5**.

5.2 Target Area

A large city zone, including a metropolitan city, and surrounding areas containing cities within/between which a number of one-day trips are to be enabled.

5.3 Applicable Transportation Modes for Smart Transportation

Applicable transportation modes are shown below for smart transportation according to the transportation distance in a target large city zone:

a) Both buses and HSR for transportation distances of less than 200 km; and
b) HSR for transportation distances over 200 km.

When smart transportation is applied to transportation distances of less than 200 km, consider the conditions in **5.5**.

5.4 Requirements for Smart Transportation

5.4.1 *General*

The services provided by a transportation mode selected as smart transportation shall satisfy the conditions specified in **5.4.2** to **5.4.4**.

5.4.2 *Customer Satisfaction*

5.4.2.1 *Service frequency*

The transportation service shall be available every hour minimum, even in off-peak periods, and every 5 min maximum during rush hours.

5.4.2.2 *Transportation capacity*

The possible capacity shall be over 500 persons per hour.

5.4.2.3 *Main station location*

Main stations shall be situated in or close to the city centre.

5.4.2.4 *Connection to/from the station for smart transportation*

Connection services by rail, bus, ferry, airplane, walking, bicycle, bike or car shall be provided to customers for their ease of access to smart transportation.

5.4.2.5 *Service route*

The route shall include as many cities as possible by avoiding excessive increases in travel time from terminal to terminal.

5.4.2.6 *Roads/tracks*

The roads/tracks to be used for smart transportation shall enable on-time operation of highway buses and HSR trains and have no level crossings.

5.4.2.7 *Schedule speed*

The schedule speed can be increased by improving acceleration.

NOTE — Schedule speed is given by dividing the one-way distance between terminals by the scheduled travel time.

5.4.2.8 *Increases in number of stops/stations*

The number of stops/stations for smart transportation shall be increased, if needed, by consulting with municipalities on the service route, even after the services start.

5.4.2.9 *Transportation information*

Any transportation information helpful to customers in recognizing their departure and arrival stations and those for changes to other services shall be provided through maps and web applications.

5.4.3 *Safety*

5.4.3.1 *Dispatching*

All service vehicles for smart transportation are dispatched and controlled at a dispatching/operation control center through wireless communication.

NOTE — Dispatching centers are also called operation control centers.

5.4.3.2 *Immediate stopping*

The immediate stopping of vehicles in order to prevent accidents shall be ensured in the operation of smart transportation systems.

5.4.4 *Efficiency of Operation and Services*

5.4.4.1 *Vehicle structures*

Lighter vehicles shall be used in order to help reduce the cost of infrastructure for smart transportation.

5.4.4.2 *Coach convenience*

Entry and exit from vehicles shall be easy and accessible for all, including the elderly and those with small children or disabilities, so that passengers are able to enter and exit with minimal or no assistance. Vehicles shall be equipped with handgrips and non-slip floors for safety and furnished with easy communication channels in case of emergency. Vehicles may also include space devoted to bicycles or other large items.

5.4.4.3 *Promotion of environmentally friendly vehicles and life-cycle performance*

Transportation systems which produce low chemical emissions, vibration and noise levels shall be used. Furthermore, positive application of technologies shall be promoted to develop environmentally friendly vehicles and enhance the life-cycle performance of the transportation.

5.4.4.4 *Ticket inspection*

No inspection work is required onboard for reserved seats. Tickets shall be inspected at entry of stations.

5.4.4.5 *Energy saving*

Transportation systems shall be used which can save energy by, for example, using recovered braking energy, minimizing energy consumption, optimizing operation schedules or controlling vehicle running performance.

5.4.5 *Strategies to Stimulate Business/ Commercial Activities*

Area around the station located in the city centre and designate for commercial business district are to be delineated. While delineating area for planning purpose, the forward and backward linkages of the parameters must be kept in mind and relevant parameters be selected for the delineation process.

5.4.6 *Finance and Funding*

5.4.6.1 *Transport finance strategies*

The basic principle in financing would be that the government should provide the infrastructure but the users (direct and indirect beneficiaries within the city) must pay for the operating costs and the rolling stock. While considering transport finance, the following parameters should be taken into consideration:

a) Willingness to introduce premium public transport systems that are priced high but offer better quality with a view to limit the subsidy requirements in normal services;

b) Extent of resources likely from private participation;

c) Initiatives taken to promote non-motorized transport and improve safe access to public transport;

d) Willingness to price public transport systems in such a manner as to be financially sustainable at the operating stage or depend only marginally on public budgets;

e) Extent of resources mobilized by the state government through exploitation of its land resources;

f) Willingness to involve the private sector in operations under the overall supervision and coordination of a public agency;

g) Willingness to divert funds from projects that add to road capacity towards public transit systems; and

h) Institutional mechanisms set up by the State government to ensure a well-coordinated public transport system.

5.4.6.2 *Public/private partnership*

The private sector can be beneficially engaged, thereby saving financial resources for activities that only public agencies can best perform under conditions that strike a fair balance between the universal obligations of the government and the profit motive of the private operator. On balance, the Central Government should encourage the State Governments to involve the private sector in providing public transport services, but under well-structured procurement contracts.

The private sector companies can add significant value to government’s efforts for promoting energy-efficient, low-carbon transport, including through: (i) Offering technical inputs to develop viable financial models and instruments, which encourage long-term private investments and capacity-development for building sustainable transport systems; (ii) Assisting standardization including for low-carbon fuels in relevant category of transport products; (iii) Investing in R&D to develop low-carbon, energy-efficient transport products and services including in developing country context; and (iv) Developing business models aimed at establishing low-carbon supply chain and partnering with suppliers with high share of energy consumption from renewable sources, among others.

5.4.6.3 *Value capture of assets*

Value Capture as practiced widely in the world is based on the principle that private land and buildings benefit from public investments in infrastructure and policy decisions of Governments (for example, change of land use or FSI). Some of the methods for value capture of assets are:

a) Land value tax — is considered the most ideal value capture tool which apart from capturing any value increment, helps stabilize property prices, discourage speculative investments and is considered to be most efficient among all value capture methods;

b) Fees for changing land use (agricultural to non-agricultural);

c) Betterment levy — one-time upfront charge on the land value gain caused by public infrastructure investment;

d) Development charges (impact fees) are area based and link the development charge to the market value of land by carrying out periodic revisions;

e) Transfer of Development Rights (TDRs) — used for trading development rights;

f) Premium on relaxation of rules or additional FSI/FAR — widely used in States such as Maharashtra, Karnataka, Gujarat, Tamil Nadu, etc, to allow for addition of a development rights beyond the permissible limits in the *State Town Planning Laws and Regulations*;

g) Vacant land tax (VLT) — is applicable on those landowners who have not yet initiated construction on their lands;

h) Tax increment financing (TIF) — is one of the most popular value capture tools in many developed countries, especially the United States;

j) Land acquisition and development — acquiring and developing land could be adopted as a useful value capture method to mobilize resources; and

k) Land pooling system (LPS) — is a form of land procurement where all land parcels in an area are pooled, converted into a layout.

5.5 Selection of a Transportation Mode for Smart Transportation

Select a transportation mode for smart transportation by considering the following transport conditions to solve specific city issues:

a) Transportation distance of target sections;
b) Transportation capacity required for target sections;
c) Transportation service frequency requested for target sections;
d) Fare payable by customers travelling in target sections; and
e) Cost to facilitate transportation facilities and vehicles for smart transportation to be installed in target sections.

5.6 Installation of Smart Transportation

By using the transportation mode selected, a system of smart transportation shall be established in accordance with the requirements described in **5.4**.

6 MAINTENANCE OF THE QUALITY OF SMART TRANSPORTATION FOR RAPID TRANSIT

6.1 General

To maintain the performance of smart transportation for rapid transit and confirm its effectiveness, the parameters shown in **6.2** shall be periodically observed. If the effectiveness of smart transportation cannot be confirmed, modify the current smart transportation services by partly changing the transportation conditions described in **5.4**, where possible and reasonable.

6.2 Parameters to be Observed

To ensure that the performance of smart transportation is effectively organized, observe any changes in the following parameters:

a) Population in the large city zone or urban agglomeration where smart transportation was installed;
b) Traffic flows to/from the target area;
c) The modal split of smart transportation in the target area;
d) The required capacity of smart transportation;
e) City zone axes of the target area; and
f) Parameters developed based on proven measures for transit performance.

6.3 Modification of Smart Transportation

When identifying unwanted changes in the value of the parameters designated in **6.2**, modify the conditions of smart transportation as laid out in **5.4**, where possible. To correct the transportation parameters, analyse any unexpected or irregular occurrences in the area where smart transportation was installed. Modify the irregular conditions of the smart transportation system if the irregular conditions are not acceptable.

ANNEX A

(*Foreword*)

EXAMPLES OF SMART TRANSPORTATION THAT WORKS AS RAPID TRANSIT SERVICES

Table 1 shows typical examples of smart transportation between cities and in large city zones, including megalopolises, available to citizens making a one-day trip in the respective areas.

Table 1 Typical Examples of Smart Transportation for Rapid Transit between Cities or within a Large City Zone

		City Zone (Megalopolis)									
Sl No. (1)	**Service Conditions** (2)	**New York - Philadelphia, US** (3)	**Los Angeles - San Diego, US** (4)	**Vienna - Brno - Prague, EU** (5)	**Seoul - Daejeon, Republic of Korea** (6)	**Bangkok - Pattaya, Thailand** (7)	**BosWash, US** (8)	**Blue Banana, EU** (9)	**The Tokaido Megalopolis, Japan** (10)	**Beijing - Tianjin Economy Zone, China** (11)	**Four Metropolitan City Zone, Taiwan** (12)
i)	Population in the area/10^6 persons	10	13	3	12	6	52	100	67	36	14
ii)	Transportation mode	Highway bus	Highway bus	Highway bus	Highway bus	Highway bus	HSR	HSR	HSR	HSR	HSR
iii)	Service distance/ km	155	194	340	153	147	735	492, between London and Paris	515	120	345
iv)	Maximum service frequency (service interval)/min	60	60	110	15	30	60	60	5	5	5

Table 1 (*Concluded*)

City Zone (Megalopolis)											
Sl No. (1)	**Service Conditions** (2)	**New York - Philadelphia, US** (3)	**Los Angeles - San Diego, US** (4)	**Vienna - Brno - Prague, EU** (5)	**Seoul - Daejeon, Republic of Korea** (6)	**Bangkok - Pattaya, Thailand** (7)	**BosWash, US** (8)	**Blue Banana, EU** (9)	**The Tokaido Megalopolis, Japan** (10)	**Beijing - Tianjin Economy Zone, China** (11)	**Four Metropolitan City Zone, Taiwan** (12)
v)	Minimum service frequency (service interval)/min	120	168	240	35	40	120	80	30	30	60
vi)	Maximum service speed/km/h	78 (schedule speed)	83 (schedule speed)	74 (schedule speed)	77 (schedule speed)	49 (schedule speed)	240	300	285	240	300
vii)	Average service speed/km/h	80	90	80	80	50	110	210	220	200	230
viii)	Travel time between terminals/h	2	2.2	4.4	2	3	7	2.3	2.3	0.6	1.5

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Smart Cities Sectional Committee, CED 59

Organization	*Representative(s)*
In Personal Capacity (*G-1602, Pioneer Park, Sector 61, Gurugram - 122001*)	DR SUDHIR KRISHNA **(*Chairperson*)**
AECOM India Private Limited, Gurugram	SHRI PAWAN KUMAR JAIPURIAR SHRI ARVIND AGRAWAL (*Alternate*)
AFCONS infrastructure Limited, New Delhi	REPRESENTATIVE
Ahmedabad Municipal Corporation, Ahmedabad	REPRESENTATIVE
All India Institute of Local Self Government, Mumbai	SHRI ADVAIT AUNDHKAR
Bhubaneshwar Smart City Limited, Bhubaneshwar	SHRI KAMALJIT DAS SHRI SAROJ RANJAN DASH (*Alternate*)
Building Materials and Technology Promotion Council, New Delhi	SHRI J. K. PRASAD
Builders Association of India, New Delhi	SHRI DHARMESH AWASTHI SHRI ARUN SAHAI (*Alternate*)
Central Statistics Office, Ministry of Statistics and Programme Implementation, New Delhi	SHRI ANAND JOSHI
Cochin Smart City Limited, Kochi	REPRESENTATIVE
Confederation of Indian Industry, New Delhi	SHRI VIRENDER SINGH
Confederation of Real Estate Developers' Association of India, New Delhi	REPRESENTATIVE
Delhi Development Authority, New Delhi	SHRIMATI LEENU SEHGAL SHRIMATI MANJU PAUL (*Alternate*)
Delhi-Mumbai Industrial Corridor Development Corporation Limited, Mumbai	CHAIRPERSON
Department of Telecommunication, Ministry of Communications, New Delhi	SHRI SANJAY KUMAR SHRI DIRECTOR (NT-III) (*Alternate*)
Federation of Indian Chambers of Commerce & Industry, New Delhi	SHRI JAYANT KOHALE MS DEBASHISH ROY (*Alternate*)
Greater Corporation Chennai, Chennai	SHRI B. V. BABU SHRI S. SUDHAKAR (*Alternate*)
Greater Vishakhapatnam Smart City Corporation Limited, Vizag	REPRESENTATIVE

Organization	*Representative(s)*
Gujarat International Finance, Tec-City Company Limited, Gandhinagar	Shri Loveleen Garg
Guwahati Municipal Corporation, Guwahati	Representative
Indian Concrete Institute, Chennai	Shri K. P. Abraham
Indian Green Building Congress, New Delhi	Ms Sheetal Rakheja
Indian Institute of Remote Sensing, Dehradun	Representative
Indian Institute of Technology Kharagpur	Prof Uttam K. Banerjee
Institute of Town Planners, New Delhi	Shri B. C. Datta Prof S. K. Kulshreshtha (*Alternate*)
Jabalpur Smart City Limited, Jabalpur	Representative
Jammu Municipal Corporation, Jammu	Representative
Karki Associates, New Delhi	Shri Rajnish Karki
Ministry of Commerce & Industry, New Delhi	Shri Sudhanshu Pandey
Ministry of Consumer Affairs, Food & Public Distribution, New Delhi	Director (BIS) Under Secretary (BIS) (*Alternate*)
Ministry of Drinking Water & Sanitation, New Delhi	Shri D. Rajshekhar Shri G. Balasubramaniyam (*Alternate*)
Ministry of Earth Sciences, New Delhi	Dr M. Mohapatra Dr O. P. Mishra (*Alternate*)
Ministry of Electronics & Information Technology, New Delhi	Ms Kavita Bhatia Shri Mayank (*Alternate*)
Ministry of Housing & Urban Affairs, New Delhi	Shri Kunal Kumar Shri Sampath Kumar S. (*Alternate*)
Ministry of New & Renewable Energy, New Delhi	Dr A. K. Tripathi Dr G. Prasad (*Alternate*)
Ministry of Panchayati Raj, New Delhi	Joint Secretary
Ministry of Power, New Delhi	Shri Saurabh Diddi (*Alternate*)
Ministry of Rural Development, New Delhi	Representative
Ministry of Statistics & Programme Implementation, New Delhi	Shri Brijendra Singh Shri Gopal Saha (*Alternate*)
Ministry of Tourism, New Delhi	Dr Ravi Kant Bhatnagar
Ministry of Transport, New Delhi	Representative
Ministry of Water Resources, River Development & Ganga Rejuvenation, New Delhi	Shri R. K. Jain Shri G. C. Pati (*Alternate*)

Organization	*Representative(s)*
Narnix Technolabs Private Limited, New Delhi	Shri N. Kishore Narang
National Association of Software & Services Companies, Noida	Shri Manojit Bose Ms Rama Vedashree (*Alternate*)
National Highway Authority of India, New Delhi	Shri Ajay Sabarwal
National Real Estate Development Council, New Delhi	Shri Navin Raheja Brig R. R. Singh (*Alternate*)
National Remote Sensing Centre, Hyderabad	Dr S. C. Jayanthi Shri B. D. Bharath (*Alternate*)
North East Space Application Centre, Shillong	Representative
Office of the Registrar General & Census Commissioner, New Delhi	Representative
Ranchi Municipal Corporation, Ranchi	Representative
Saviram Engineering Consultants Private Limited, Noida	Shri Girish Mishra
School of Planning and Architecture, New Delhi	Shri vinay maitri Dr Sanjukkta S. Bhaduri (*Alternate*)
Shillong Smart City Limited, Shillong	Representative
Smart Cities Next, New Delhi	Representative
Sulabh International Social Service Organization, New Delhi	Prof K. J. Nath Dr N. B. Mazumdar (*Alternate*)
Surat Smart City Development Limited, Surat	Representative
Survey of India, Dehradun	Representative
Svayam National Centre for Inclusive Environment, New Delhi	Shri Navin Kumar Nayan Shri J. M. Syal (*Alternate*)
Town and Country Planning Organization, New Delhi	Shri R. Srinivas Shri Nitin Kumar Azad (*Alternate*)
Udaipur Smart City Limited, Udaipur	Representative
Unified Traffic & Transportation Infrastructure (P & Engg) Centre, New Delhi	Shrimati Manju Paul Shri Manish Verma (*Alternate*)
University of Delhi, New Delhi	Dr C. R. Babu
Urban Development Department, Town & Country Planning Branch, Kolkata	Shri Satanu Prasad Kar Ms Sandhyatra Saha (*Alternate*)
Urban Governance, Administrative Staff College of India, Hyderabad	Prof Srinivas Chary Vedala
V. V. Giri National Labour Institute, Noida	Representative

Organization	*Representative(s)*
WRI (India), New Delhi	Shri Amit Bhatt Ms Prerna V. Mehta (*Alternate*)
In Personal Capacity (*L/109, Sarita Vihar, New Delhi - 110076*)	Shri Ashok Khurana
In Personal Capacity (*374, Sector 28, Noida - 201301*)	Dr Sandeep Garg
In Personal capacity (*B-399, 2nd Floor, Meera Bagh, Paschim Vihar, New Delhi - 110063*)	Shri Satish Kumar
In Personal Capacity (*1/5 Shabd Pratap, Asharam, Lashkar, Gwalior - 474012*)	Shri S. P. Bansal
In Personal Capacity (*Isavasyam, TC 18/1023, B-8/2, Lakshmi Nagar, Kesavadasapuram, Pottam P. O. Thiruvananthapuram - 695004*)	Shri V. Suresh
BIS Directorate General	Shri Arunkumar S., Scientist 'E'/Director and Head (Civil Engineering) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri Sinam Hudson Singh
Scientist 'D'/Joint Director
(Civil Engineering), BIS

Working Group on Smart Cities, CED 59/WG1

Organization	*Representative(s)*
In Personal Capacity (*G-1602, Pioneer Park, Sector 61, Gurugram - 122001*)	Dr Sudhir Krishna **(*Convener*)**
Gujarat International Finance Tec-City Company Limited, Gandhinagar	Shri Loveleen Garg
Indian Concrete Institute, Chennai	Shri K. P. Abraham
Ministry of Housing and Urban Affairs, New Delhi	Shri Sampath Kumar S.
Narnix Technolabs Private Limited, New Delhi	Shri N. Kishore Narang
School of Planning & Architecture, New Delhi	Dr Sanjukkta S. Bhaduri
Town and Country Planning Organization, New Delhi	Shri R. Srinivas
WRI (India), New Delhi	Ms Prerna Mehta
In Personal Capacity (*B-399, 2nd Floor, Meera Bagh, Paschim Vihar, New Delhi - 110063*)	Shri Satish Kumar

This Page has been Intentionally left blank

This Page has been Intentionally left blank

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Head (Publication & Sales), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

This Indian Standard has been developed from Doc No.: CED 59 (21650).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.

Published by BIS, New Delhi